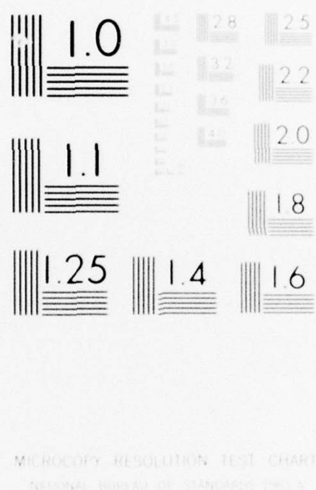
AD-A044 072   CALIFORNIA UNIV SAN DIEGO LA JOLLA INST FOR PURE AND--ETC F/G 18/4
PREPARE, CALIBRATE AND FLY A PROGRAMMABLE LOW-ENERGY PARTICLE D--ETC(U)
SEP 77   S E DEFOREST   N00014-76-C-0432

UNCLASSIFIED   NL

1 OF 1
AD
A044072

END
DATE
FILMED
10-77
DDC


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(15) N00014-76-C-0432

(12)

(6) PREPARE, CALIBRATE AND FLY A PROGRAMMABLE LOW-ENERGY PARTICLE DETECTION INSTRUMENT ON BOARD THE SCATHA SATELLITE.

(10) Sherman E./DeForest

Institute for Pure and Applied Physical Sciences
University of California, San Diego
La Jolla, California 92093

(11) 1 Sep[redacted]977

(12) 7p.

(9) Final Report for Period 1 Jan[redacted]976 — 31 Jul[redacted]977

OFFICE OF NAVAL RESEARCH
UNITED STATES NAVY
ARLINGTON, VIRGINIA 22217

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS
BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Prepare, Calibrate and Fly a Programmable Low-Energy Particle Detection Instrument on Board The SCATHA Satellite

5. TYPE OF REPORT & PERIOD COVERED
Final Report - 1 Jan 1976 - 31 July 1977.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Sherman E. DeForest

8. CONTRACT OR GRANT NUMBER(s)
N0014-76-C-0432 new

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Institute for Pure and Applied Physical Sciences
University of California, San Diego
La Jolla, California 92093

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
Office of Naval Research
Arlington, Virginia 22217

12. REPORT DATE
1 September 1977

13. NUMBER OF PAGES
6

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
Contract N00014-76-C-0432 expired on 31 July 1977. This report summarizes the progress made ~~until that time~~ on the preparation of the SC-9 plasma particle instrument for flight on the SCATHA space vehicle. In what follows, it is important to remember that this contract had been part of a continuing program which is currently being supported by the Air Force. This means that all work reported here will be of the nature of work in progress or milestones which have been met. The actually delivery of the instrument in flight configuration will not come until the first part of 1978. Launch of SCATHA is currently scheduled for the first part of 1979.
(continued on back)

20. cont..

The history of this project is long and complicated. Originally UCSD proposed to fly an ATS-5 flight spare instrument with suitable refurbishment and calibration. Then several agencies became involved with the problems of spacecraft charging. By the time the concept of SCATHA was established, the prototype instrument of the ATS-6 plasma instrument was available. This instrument is a vastly improved version of what had been flown on ATS-5. It detects particles over a much wider energy range and features sensing heads which rotate in two perpendicular directions. A major problem with either instrument is that they were built to interface to a specific spacecraft which had a considerably different configuration from SCATHA. This necessitated the construction of an interface box which not only prepares the telemetry signals, but does such things as accumulate the output signals (on ATS-6 accumulation and log compression were spacecraft functions). This in turn required the design and construction of a totally new ground support equipment.

In the sections that follow, we will describe the progress made on the program up to the ending of this contract and transfer of all remaining responsibility to the Air Force.

1.0 SUMMARY

Navy contract N00014-76-C-0432 was modified to provide a no-cost extension from 1 April 1977 to 31 July 1977. This overlapped slightly the proposed start of the Air Force funding, but the tasks to be performed during this period were detailed in UCSD proposal 8948, dated 30 March 1977. This extension was granted, and with that additional time, we were able to complete the tasks described in the proposal. These included the electrical design and fabrication of a power simulator, the 3 KHz analog display drivers and the stimulus card for the CAMAC interface to the ground test equipment for the above. These were all completed satisfactorily. However, the software for appropriate display of the 3 KHz channel was not completed until after this contract had expired. The spacecraft power simulator is essentially a variable power supply which can be controlled on-line by the PDP 11/34 which constitutes the core of the GSE.

During the extra four months we also completed the electrical testing of the above mentioned items and made all necessary modifications to optimize their performance in actual use.

During the earlier phases of this contract, all other goals had been achieved. This included the final design of the telemetry interface electronics,layout of all logic sticks, and construction and testing of the various electronic subassemblies. Note that the design of GSE that we are using allows us to simulate the interface not only to the instrument proper, but also to any subassembly. All that is required is the appropriate software and interconnections. This has greatly simplified and improved our testing capability.

Although the logic sticks have been tested, they have not yet been integrated into the flight configuration. They have been interconnected on a breadboard and then connected by appropriate harnesses to the rest of the instrument so that the whole system could be operated by the GSE.

The GSE is now completed and much of the software needed to test the individual sticks and subassemblies is also written and debugged. In fact, the test reports for the various subassemblies are standard forms produced by the GSE and signed by the operator. These then become part of the permanent records for the instrument.

Although much effort has gone into rebuilding and refurbishing the sensor and analyzers section of the instrument, no recalibration had been undertaken

before this contract expired. This is in accordance with the original schedule.

In summary, at the conclusion of this contract, the project as a whole was proceeding at the predicted pace with no major problems foreseen. Delivery on schedule of an excellent instrument looked very probable. Since the expiration date and this writing, further progress has been made. A potential weight problem has been solved; and we still predict delivery on schedule.

2.0 INSTRUMENT

The basic instrument is the ATS-6 prototype plasma detector. We have increased the height of the box by 1½ inches to allow room for the additional logic and electronics necessary to perform the interface functions. We have also added a microprocessor to aid in the distribution of commands since we have learned of the limitations on the ground control command capability for the SCATHA mission. A few other minor changes have been made to correct problems experienced by ATS-6. For instance we have replaced the motors with a larger size. Partial failure of the temperature control system on ATS-6 caused large temperature gradients to exist across the bearings. This extra stress eventually caused sticking and finally limited detector rotation to certain seasons when the temperature profile is favorable. The new motors will prevent that problem even though a similar temperature control problem on SCATHA is unlikely due to the fact that it is spinning while ATS is stabilized with one axis pointing toward earth.

The grid cones at the rear of the analyzing section have been changed from wires stretched over a delrin frame to wires over a metal frame mounted on insulating standoffs. This was a simple change which will prevent charge buildup in the analyzing volume. This effect can affect the detection of very low energy particles in the presence of large fluxes of energetic particles. No other change has been made to the detectors themselves.

Temperature control on ATS-6 was through an active device located directly below our instrument. In the SCATHA configuration, the instrument is located on one end of the vehicle. This isolation means that careful control of the external surfaces must be maintained. Recently developed paints are now available for thermal control which are also good electrical conductors. Based on thermal calculations performed at Martin Marietta, a paint pattern has been developed which will insure good thermal properties while satisfying our need for conducting outer surfaces.

The main work left to be done on the instrument is the integration into flight configuration (which is being done at this writing) and calibration. The microprocessor units have not yet been fabricated due to delayed delivery of parts, but this does not pose a problem for eventual timely delivery.

3.0 GROUND SUPPORT EQUIPMENT

The philosophy at UCSD for ground support equipment is somewhat different from that of other laboratories. We believe in being able to test all subsystems and the complete instrument in as near to spacecraft configuration as possible. This includes the ability to make tapes in spacecraft format. In this manner, we not only are able to test the instrument under realistic conditions, but we are also able to start development of software to analyze data long before launch. In fact, the checkout software can easily be incorporated into the final analysis programs. This means that the GSE itself is more cumbersome than for other experiments, but that the overall cost to the program is greatly reduced. This is particularly true in the SCATHA case since we have chosen to use a PDP 11/34 as the basis of the GSE. The other approach is to build special purpose equipment which will have no use after launch. The 11/34 will serve not only before launch, but will also act as an important part of the data reduction equipment. In the event of a follow-on or related program, the same central unit could be used again. This would result in quite substantial savings to the second program.

We use the CAMAC standard to interface the instrument to the computer. This has several advantages such as being relatively easy to construct a second CAMAC crate to run from our laboratory PDP 11/70. This avoids the necessity of constructing two complete GSE's during those phases when testing might be done at both UCSD and Martin.

The GSE itself consists of the 11/34, dual floppy discs, CAMAC crate and controller, a tape unit, terminal, and line printer. All of this is assembled and working. The language we use is FORTH, an interactive reverse Polish notation language specifically designed for controlling scientific instruments in real time. Software for all major functions except testing of the 3 KHz analog output have been written and tested at the expiration of this contract. Further development is continuing at the time of this writing, and the 3 KHz test procedure now works.

4.0 SOFTWARE

As has been repeatedly mentioned in the previous sections, software development is a very important part of the SC-9 instrument program. This is a continuing task. Frequently software development is being done in parallel with the actual construction of parts to be tested. Improvements are made from time to time as we get more familiar with the assembled instrument. This flexibility of testing capability has already proven to be very valuable.

At the expiration of this contract, sufficient software existed to test all of the logic sticks which had been designed and constructed.

In addition, we are able to drive the whole instrument in a spacecraft mode. We can read data and send commands. All responses are automatically checked and appropriate messages printed out.

Through the programmable power supply, we can automatically simulate various possible spacecraft power configurations.

We can store data taken during tests and later analyze it in much greater detail than is possible in real time. Alternatively, we have the ability to monitor and plot selected data as it is generated.

All of these features had been programmed and checked at the time of the expiration of this contract. However, development of several of the main programs is continuing.

5.0 WORK LEFT TO DO

As has been indicated above, the work which this contract calls for has been completed, but the program itself is far from complete. Work is currently being supported under Air Force sponsorship. We anticipate no major problems in completing delivery of the instrument.

6.0 INVENTIONS AND SUBCONTRACTS

We believe that no new inventions have been developed during the course of this contract. No subcontracts are currently outstanding.